

WHAT IS CLAIMED IS:

1. A method for providing a transport protocol within a lossy network, comprising:

receiving multiple packets, wherein each of the received packets includes a header and an associated sequence number, wherein the header includes a congestion alleviation indication and an impending congestion indication;

monitoring the network for congestion caused by the received packets;

marking the header of some of the packets with an impending congestion indication based on the outcome of the monitoring;

transmitting the monitored multiple packets through the lossy network;

returning acknowledgements of receipt for each of the transmitted packets, based on the sequence number associated with each of the packets, and any associated marked impending congestion indication and the congestion alleviation indication;

monitoring each of the received acknowledgements for the sequence number and the marked impending congestion indication associated with each of the received packets; and

invoking a congestion control mechanism to control a congestion window size which regulates the transmitted packets based on the monitoring of the acknowledgements and the marked impending congestion indication, and further marking the header with a congestion alleviation indication.

2. The method of claim 1, wherein monitoring the network for congestion, comprises:

monitoring the number of packets waiting in line to be transmitted; and

comparing the number of packets waiting in line to a predetermined minimum line size and a predetermined maximum line size.

3. The method of claim 2, wherein marking the header of some of the packets with an impending congestion indication, comprises:

if the number of packets waiting in line is greater than the predetermined minimum line size and less than the predetermined maximum line size, then marking the header of some of the received packets based on a predetermined probability with an impending congestion indication; and

if the number of packets waiting in line is greater than the predetermined maximum line size, then the packets waiting in line beyond the predetermined maximum line size will be dropped.

4. The method of claim 3, wherein monitoring each acknowledgement for the sequence number and the marked impending congestion indication, comprises:

monitoring acknowledgements for a number of consecutively received same sequence numbers; and

if the number of consecutively received acknowledgements with the same sequence number is greater than or equal to a predetermined number, then checking the acknowledgements for a marked impending congestion indication.

5. The method of claim 4, wherein invoking a congestion control mechanism, comprises:

if the acknowledgement is marked with an impending congestion indication, then invoking the congestion control mechanism.

6. The method of claim 5, further comprising:

if the acknowledgement is not marked with an impending congestion indication, then the congestion control mechanism will not be invoked.

7. The method of claim 4, further comprising:
 if the acknowledgement is not marked with an impending congestion indication then the congestion window size will be reduced by a predetermined small amount to regulate the transmitted packets.

8. The method of claim 1, further comprising:
 providing a forward error correction to the header of each packet.

9. The method of claim 1, wherein marking the header of some of the multiple packets with an impending congestion indication, comprises:
 flagging CE (Congestion Experienced) bits in the header of some of the multiple packets; and
 flagging a CWR (Congestion Window Reduced) bit in the header of some of the multiple packets.

10. The method of claim 9, wherein returning acknowledgements comprise:
 flagging an ECE (Explicit Congestion Notification Echo) bit in the acknowledgements.

11. The method of claim 1, wherein the predetermined number is 3 or more consecutive acknowledgements including a same sequence number.

12. A computer readable medium having computer-executable instructions for providing a transport protocol within a lossy network, comprising:
 receiving multiple packets, wherein each of the received packets includes a header and an associated sequence number, wherein the header includes a congestion alleviation indication and an impending congestion indication;
 monitoring the network for congestion caused by the received packets;
 marking the header of some of the packets with an impending congestion indication based on the outcome of the monitoring;

transmitting the monitored multiple packets through the lossy network;
returning acknowledgements of receipt for each of the transmitted packets,
based on the sequence number associated with each of the packets, and any
associated marked impending congestion indication and the congestion alleviation
indication;

monitoring each of the received acknowledgements for the sequence number
and the marked impending congestion indication associated with each of the
received packets; and

invoking a congestion control mechanism to control a congestion window
size which regulates the transmitted packets based on the monitoring of the
acknowledgements and the marked impending congestion indication, and further
marking the header with a congestion alleviation indication.

13. The computer readable medium of claim 1, wherein monitoring the network
for congestion, comprises:

monitoring the number of packets waiting in line to be transmitted; and
comparing the number of packets waiting in line to a predetermined
minimum line size and a predetermined maximum line size.

14. The computer readable medium of claim 13, wherein marking the header of
some of the packets with an impending congestion indication, comprises:

if the number of packets waiting in the line is greater than the predetermined
minimum line size and less than the predetermined maximum line size, then
marking the header of some of the received packets based on a predetermined
probability with an impending congestion indication; and

if the number of packets waiting in line is greater than the predetermined
maximum line size, then the packets waiting in line beyond the predetermined
maximum line size will be dropped.

15. The computer readable medium of claim 14, wherein monitoring each acknowledgement for the sequence number and the marked impending congestion indication, comprises:

monitoring acknowledgements for a number of consecutively received same sequence numbers; and

if the number of consecutively received acknowledgements with the same sequence number is greater than or equal to a predetermined number, then checking the acknowledgements for a marked impending congestion indication.

16. The computer readable medium of claim 15, wherein invoking a congestion control mechanism, comprises:

if the acknowledgement is marked with an impending congestion indication, then invoking the congestion control mechanism.

17. The computer readable medium of claim 16, further comprising:

if the acknowledgement is not marked with an impending congestion indication, then the congestion control mechanism will not be invoked.

18. The computer readable medium of claim 15, further comprising:

if the acknowledgement is not marked with an impending congestion indication, then the congestion window size will be reduced by a predetermined small amount to regulate the transmitted packets.

19. A computer system for providing a transport protocol within a lossy network, comprising:

a storage device;

an output device; and

a processor programmed to repeatedly perform a method, comprising:

receiving multiple packets, wherein each of the received packets includes a header and an associated sequence number, wherein the header includes a congestion alleviation indication and an impending congestion indication;

monitoring the network for congestion caused by the received packets;

marking the header of some of the packets with an impending congestion indication based on the outcome of the monitoring;

transmitting the monitored multiple packets through the lossy network;

returning acknowledgements of receipt for each of the transmitted packets, based on the sequence number associated with each of the packets, and any associated marked impending congestion indication and the congestion alleviation indication;

monitoring each of the received acknowledgements for the sequence number and the marked impending congestion indication associated with each of the received packets; and

invoking a congestion control mechanism to control a congestion window size which regulates the transmitted packets based on the monitoring of the acknowledgements and the marked impending congestion indication, and marking the header further with congestion alleviation indication.

20. The system of claim 19, wherein monitoring the network for congestion, comprises:

monitoring the number of packets waiting in line to be transmitted; and

comparing the number of packets waiting in line to a predetermined minimum line size and a predetermined maximum line size.

21. The system of claim 20, wherein marking the header of some of the packets with impending congestion indication, comprises:

if the number of packets waiting in line is greater than the predetermined minimum line size and less than the predetermined maximum line size, then

marking the header of some of the received packets based on a predetermined probability with an impending congestion indication; and

if the number of packets waiting in line is greater than the predetermined maximum line size, then the packets waiting in the line beyond the predetermined maximum line size will be dropped.

22. The system of claim 21, wherein monitoring each of the acknowledgements for the sequence number and the marked impending congestion indication, comprises:

monitoring acknowledgements for a number of consecutively received same sequence numbers; and

if the number of consecutively received acknowledgements with the same sequence number is greater than or equal to a predetermined number, then checking the acknowledgements for a marked impending congestion indication.

23. The system of claim 22, wherein invoking a congestion control mechanism, comprises:

if the acknowledgement is marked with an impending congestion indication, then invoking the congestion control mechanism.

24. The system of claim 23, further comprising:

if the acknowledgement is not marked with an impending congestion indication, then the congestion control mechanism will not be invoked.

25. The system of claim 22, further comprising:

if the acknowledgement is not marked with an impending congestion indication, then the congestion window size will be reduced by a predetermined small amount to regulate the transmitted packets.

26. An apparatus for providing a transport protocol within a lossy network, comprising:

a sender base station to receive multiple packets from a sender and output the packets through a lossy network, wherein each of the received packets includes a header and an associated sequence number, wherein the header includes a congestion alleviation indication and an impending congestion indication;

a communication network including an analyzer to receive the outputted packets and monitor the network for congestion caused by the received packets and to further mark the header of some of the received packets with an impending congestion indication congestion bit error based on an outcome of the monitoring;

a receiver base station including a transmit module to transmit the packets through the lossy network; and

a receiver to receive the transmitted packets and to further send acknowledgements back to the sender through the communication network, wherein the acknowledgements include a sequence number associated with each of the received packets and any associated marked impending congestion indication and the congestion alleviation indication, wherein the sender monitors each of the received acknowledgements for the sequence number and the marked impending congestion indication associated with each of the received packets, and invokes a congestion control mechanism to control a congestion window size which regulates the transmitted packets based on the monitoring of the acknowledgements and the marked impending congestion indication, and further marks the header with congestion alleviation indication.

27. The apparatus of claim 26, wherein the analyzer further monitors a number of packets waiting in a line transmitted by the sender base station.

28. The apparatus of claim 26, wherein the analyzer further comprises a comparator to compare the number of received packets waiting in line with a predetermined minimum line size and a predetermined maximum line size, wherein

the analyzer marks the header of some of the received packets with the impending congestion indication, based on the outcome of the comparison.

29. The apparatus of claim 27, wherein the analyzer marks the header of some of the received packets when the number of packets waiting in line is greater than the predetermined minimum line size and less than the predetermined maximum line size based on a predetermined probability with an impending congestion indication; and

if the number of packets waiting in line is greater than the predetermined maximum line size, then the packets waiting in the line beyond the predetermined maximum line size will be dropped.

30. The apparatus of claim 29, wherein the sender monitors the received acknowledgements for a number of consecutively received acknowledgements with the same sequence number and further compares the consecutively received acknowledgements with the same sequence number with a predetermined number and outputs a first signal when the number of consecutively received acknowledgements with the same sequence number is greater than or equal to the predetermined number, and upon receiving the first signal further checks the received acknowledgements for marked impending congestion indication,

wherein the sender invokes a congestion control mechanism when the acknowledgement is marked with the marked impending congestion indication.

31. The apparatus of claim 30, wherein after receiving the first signal, the sender does not invoke the congestion control mechanism when the acknowledgement is not marked with the impending congestion indication.

32. The apparatus of claim 30, wherein after receiving the first signal, the sender reduces the congestion window size by a predetermined small amount to regulate

the transmitted packets when the acknowledgement is not marked with an impending congestion indication.

33. The apparatus of claim 26, wherein the sender further provides a forward error correction to the header of each packet.

34. The apparatus of claim 26, wherein the analyzer marking the header comprises flagging CE bits in the header.

35. The apparatus of claim 26, wherein the sender marking the header comprises flagging a CWR bit in the header.

36. The apparatus of claim 26, wherein the receiver marking the acknowledgement comprises flagging an ECE bit in the acknowledgement.

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